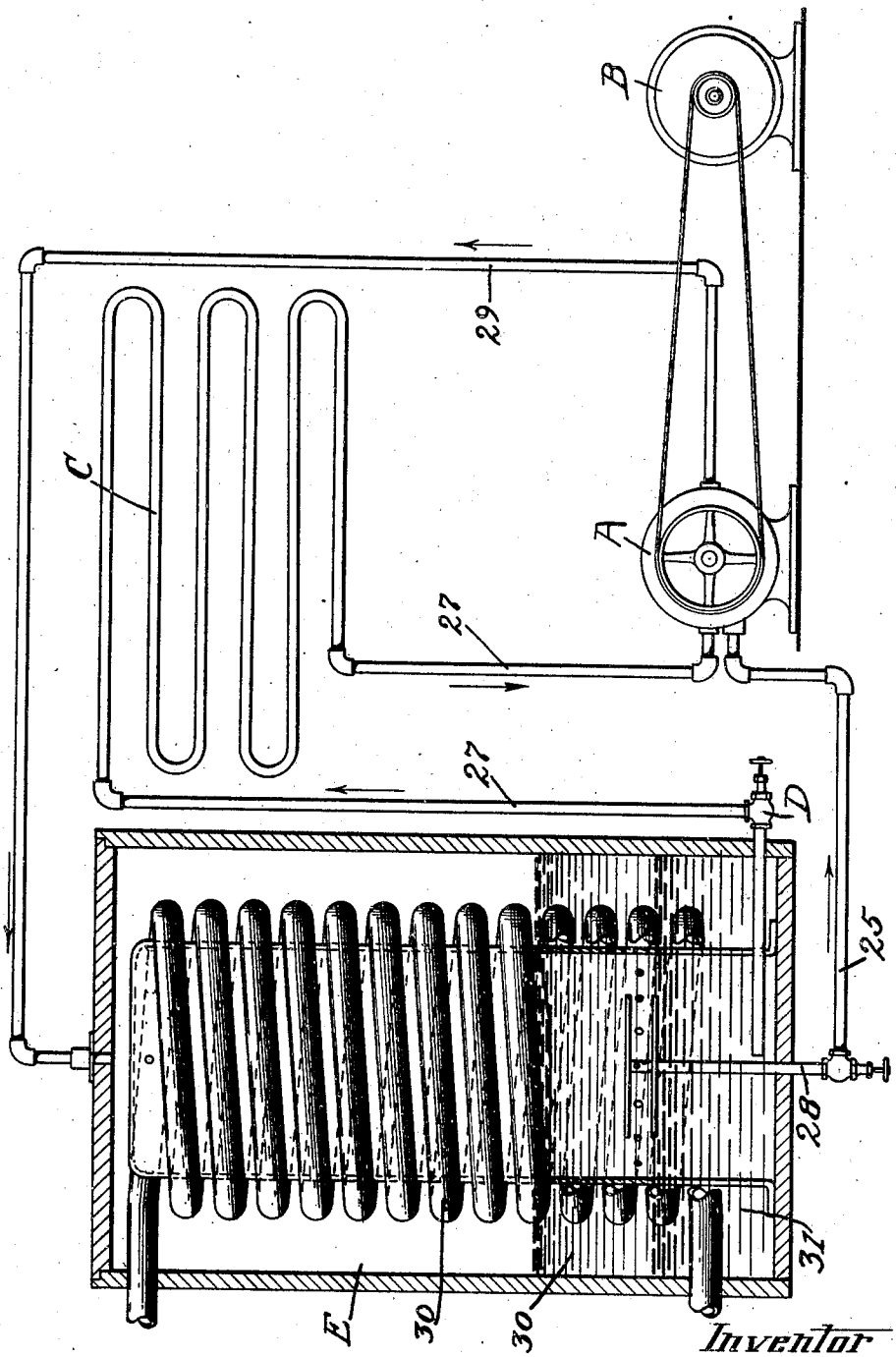
Feb. 1, 1927. 1,615,824

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ROTARY COMPRESSOR

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Fig. 1.



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Fig. 2.

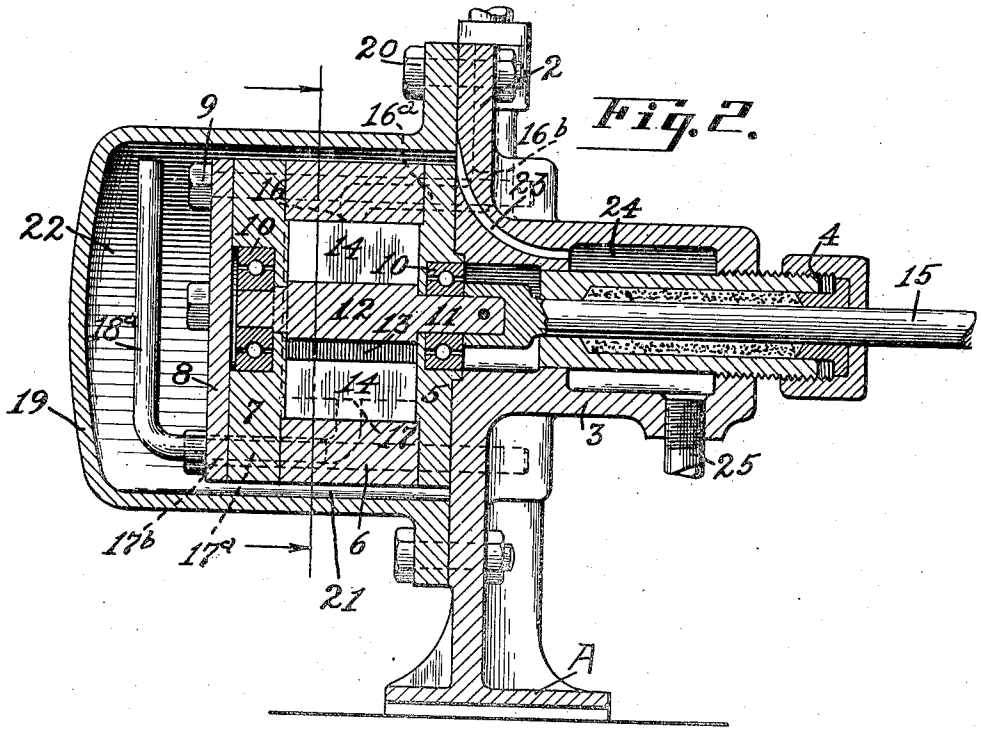
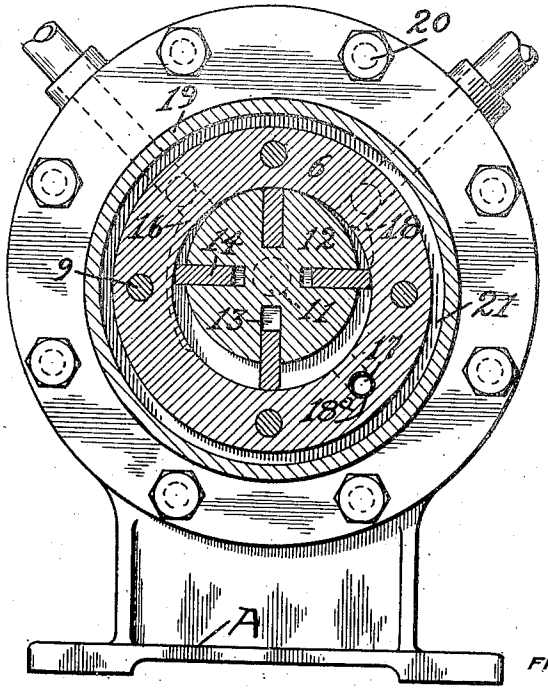


Fig. 3.



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UNITED STATES PATENT OFFICE.

FRED C. BELL, OF ALAMEDA, CALIFORNIA.

ROTARY COMPRESSOR.

Application filed February 5, 1924. Serial No. 690,789.

This invention relates to a compressor of the rotary vane type, and especially to a compressor of this character which is adapted to handle such gases as sulphur dioxide, etc. when employed in small refrigerating plants.

The object of the present invention is to generally improve and simplify the construction and operation of compressors of the character described, and further to provide a structure which permits efficient lubrication and cooling of the compressor.

One form which my invention may assume is exemplified in the following description and illustrated in the accompanying drawings, in which—

Fig. 1 is a diagrammatic view showing one form of refrigerating plant or system in which the compressor may be employed.

Fig. 2 is a central, vertical, longitudinal section of the compressor.

Fig. 3 is a cross-section on line 3—3, Fig. 2.

Referring to the drawings in detail, and particularly to Figs. 2 and 3, A indicates a base member on which is formed a circular or disk shaped head 2. Forming an extension thereof is a bearing member 3, and mounted in the outer end thereof is a stuffing box 4. Mounted on the face of the head member 2 is an inner cylinder head 5, and secured to said head are a cylinder 6, an outer cylinder head 7, and a cover plate 8; the members 5, 6, 7 and 8 being secured to the main head 2 by means of bolts 9. Mounted in the intermediate heads 5 and 7 are anti-friction bearings 10, and journalled in said bearings is a shaft 11 on which is secured a rotor 12.

The rotor proper is slotted from end to end as indicated at 13, and each slot serves as a guide and carrier for a vane 14. There are four slots and vanes employed in the present instance but the number may be increased if desired as this does not form an important feature of the present invention.

The cylinder 6 is eccentrically positioned with relation to the rotor 12 and the shaft 11 and as the vanes are free to move in the slots 13 reciprocal movement will be imparted to the vanes during rotation of the rotor; that is, the vanes will be restricted in their outward movement by the inner face of the cylinder and as such will follow or contact therewith continuously during operation of the rotor.

The rotor is driven by means of a main or driving shaft such as indicated at 15. This shaft extends through the stuffing box 4 and may be direct connected to an electric motor or other suitable driving means. The inner end of the shaft 15 is provided with a coupling and a driving connection is thus formed between the shafts 11 and 15.

The cylinder is provided with two inlet ports such as indicated at 16 and 17, and with a single discharge port as indicated at 18. The inlet port 16 is extended through one side of the cylinder and passes through the intermediate head at the point indicated at 16^a. It here communicates with a port 16^b formed in the head member 2, this port being connected with the discharge side of an expansion or cooling coil hereinafter to be referred to. The port 17, which is also an inlet port and which delivers the lubricant to the cylinder, extends through the opposite side of the cylinder and passes through communicating ports 17^a and 17^b formed in the outer head 7 and in the cover plate 8. A vertically disposed pipe 18 is connected with the port 17^b and lubricant is delivered to the upper end of this pipe as will hereinafter be described. The cylinder 6, together with the head members 5 and 7, and the cover plate 8, is entirely enclosed by an exterior cap or casing generally indicated at 19. This casing is flanged and is bolted to the main head member 2 as indicated at 20. An annular space 21 is formed between the compressor unit and the exterior casing 19 and an end space is also formed as indicated at 22 to form sufficient room for the lubricating pipe 18. The annular space 21, together with the end space 22, is filled with oil and this oil is delivered to the upper portion of the annular space by a port 23, the opposite end of which communicates with an annular space 24 formed exterior of the stuffing gland, oil being in turn delivered to the jacket or space 24 by means of a pipe 25 which is connected with a combination condenser and oil cooler hereinafter to be referred to.

The compressor here illustrated is particularly designed for use in small refrigerating plants employing sulphur dioxide

or like refrigerating medium, and for the purpose of describing its function and operation reference will be made to Fig. 1, which is a diagrammatic view showing one form of refrigerating plant in which it may be employed. In this plant A indicates the compressor, B an electric motor by which it is driven, C an expansion or cooling coil, D an expansion valve, and E a combination condenser and oil separator. The compressor, as previously stated, is provided with two inlet ports, one indicated at 16 and the other at 17. The port 16 is connected through a pipe 26 with the discharge side of the cooling or expansion coil C, while the opposite side of the coil is connected through a pipe 27 with the expansion valve D. This valve in turn communicates with the lower end of the combination condenser and oil separator as shown. The other inlet port, through which the lubricant is admitted and which is indicated at 17, is connected by means of the pipe 25 with a vertical standpipe 28 which enters the lower end of the condenser and cooler indicated at E. It extends a sufficient distance upwardly into this cooler to communicate with an oil stratum formed therein and lubricating oil in a fairly pure state is delivered thereto.

The discharge port of the compressor, indicated at 18, is connected with the combination condenser and cooler by means of a pipe 29 and a continuous cycle of circulation is thus permitted.

In actual practice when the compressor is in operation expanded gases are delivered to the suction side of the compressor through the pipe 26. This gas is compressed and is heated by the compressing action and is discharged through the pipe 29 and delivered to the upper end of the combined condenser and oil separator. The hot gases entering are mixed with oil, as will hereinafter be described, and the gases under compression, together with any oil vapors contained, will here be condensed as a cooling medium is continuously circulated through a condensing coil such as indicated at 30. The refrigerant, for instance sulphur dioxide, when liquefied or condensed is considerably heavier than the oil and they will therefore collect and separate and furthermore stratify in the lower portion of the combined condenser and oil separator, the liquefied sulphur dioxide being indicated at 31 and the oil at 32. The discharge pressure of the compressor is maintained in the condenser and oil separator as pipe 29 is in direct communication therewith and oil and liquefied sulphur dioxide will thus be discharged under pressure. The liquefied sulphur dioxide is discharged through the expansion valve D and is thus permitted to expand and assume a lower temperature when passing through the pipe 27 and the cooling or expansion coil C; the gases after completing their useful cycle being again returned to the compressor through the pipe 26. The oil is discharged through the standpipe 28 under the same pressure as the liquefied sulphur dioxide and enters the jacket of the stuffing gland 4 through the pipe 25. It is here circulated around the gland in the jacket space 24 and then passes upwardly through the port 23 from where it discharges into the annular chamber 21 and the end passage 22. The oil then circulates around the compressing unit proper and when so circulating performs two functions, first that of cooling the heated compression or discharge side of the cylinder, and secondly that of warming the cold inlet or suction side of the cylinder; that is, returning gases from the expansion coil are usually very cold, and it is for this reason that one side of the cylinder is cold and the other warm from compression. The circulation of oil around the cylinder tends to promote a uniform temperature in the compressor cylinder and as such obviates unequal expansion thereof.

The oil after performing its function of cooling the cylinder and equalizing the temperatures throughout the same finally enters the lubricating pipe 18 which communicates with the inlet port 17 of the compressor. It here serves three functions, first that of lubricating and packing the compressor, secondly that of increasing the efficiency of the compression cycle, and third that of directly absorbing heat or compression during the compression cycle. The oil thus admitted is swept or forced out through the discharge port 18 together with the compressed gases, and thus enters the pipe 29 which again returns the hot compressed gases and the oil to the combination condenser, cooler and separator, thus completing the cycle of operation which is repeated over and over again as long as the compressor is in operation.

By referring to Fig. 3 it will be noted that the inlet ports 16 and 17 are, practically speaking, positioned diametrically opposite to each other. This is important as it first of all permits each vane to sweep around and induce a complete charge of gas. This charge of gas is pocketed or trapped between two sets of vanes and lubricating oil is not delivered thereto until this trap or pocket has been completely filled. The complete filling of the pocket has taken place by the time the foremost vane of the pocket passes the lubricating port 17, and as the gas at this point is substantially atmospheric or perhaps slightly under atmospheric pressure and as the oil is maintained under a pressure equal to the discharge pressure of the compressor, it is obvious that the oil will

enter the pocket freely and will continue entering until the pressure of the gas and oil is equalized. The oil entering in this manner compresses the gas contained in the pocket and to this extent forms the initial step of the compression cycle. Further rotation of the vanes will cause the size of the pocket with entrapped gas and oil to be reduced in cubic capacity due to the eccentric position of the cylinder, and the gas will thus be finally compressed and discharged with the oil through the port 18.

By admitting the oil under pressure and at the point desired, the capacity of the compressor is not interfered with as a full charge of gas is admitted before the lubricant. The lubricant when admitted serves to partially compress this gas, and it may furthermore be stated that as the lubricant is not admitted until the compression cycle starts, it is obvious that it is applied at the proper time where it will render the best effect, as far as lubrication is concerned, as it is only during the compression cycle that leakage to any extent is liable to occur, but as the compressor is liberally supplied with lubricant at this point leakage is, as a consequence, reduced to a minimum. Again, by injecting cold oil just at the time the compressor is filled with low pressure gas, the amount of injected oil need not be restricted or in any way regulated as the gradual compression of the gas trapped between the vanes will automatically serve to restrict the quantity of oil admitted. The oil thus admitted also serves the function of absorbing a large proportion of the heat generated in the gas during the cycle of compression and as oil is a better conductor of heat than gas, it is obvious that the area of the condenser or cooler and the amount of circulating water required may be reduced.

The cooling of the cylinder unit and the stuffing box with oil is also an important factor as leakage, if any, would have no serious consequence. If water were circulated and leakage should take place, acid might be formed, particularly where sulphur dioxide is employed and corrosion would rapidly take place. This danger is, however, entirely eliminated by employing the lubricating oil for this purpose.

The arrangement of the port 23 and the oil pipe 18 is also important, that is, they both communicate with the highest points in the respective jackets, thus avoiding the formation of gas traps or pockets which might interfere with cooling and circulation of the oil.

While certain features of the present invention are more or less specifically illustrated, I wish it understood that various changes in form and proportion may be resorted to within the scope of the appended claims. I similarly wish it understood that the materials and finish of the several parts employed may be such as the experience and judgment of the manufacturer may dictate or various uses may demand.

Having thus described my invention, what I claim and desire to secure by Letters Patent is—

1. A compressor of the character described comprising a main supporting plate, a rotary compressor supported thereby, a driving shaft extending through the supporting plate to drive the compressor, a cup-shaped casing secured to the supporting plate and enclosing the rotary compressor, said cup-shaped casing being spaced therefrom to form an intermediate chamber, means for delivering oil under pressure to said intermediate chamber, and means for transferring the oil from said intermediate chamber to the compression side of the rotary compressor.

2. A compressor of the character described, comprising a main supporting plate, a cover plate, a pair of cylinder heads and an interposed cylinder secured thereto, a shaft journalled in the cylinder heads and extending through the cylinder, a rotor secured to the shaft and provided with a plurality of reciprocally mounted, radially disposed vanes, said rotor and shaft being eccentrically positioned with relation to the cylinder, a cup shaped casing enclosing the cover plate, the cylinder heads and the cylinder, said cup shaped casing being spaced therefrom to form an intermediate chamber, means for delivering oil to said chamber, means for conveying oil from the chamber to the cylinder and for delivering it to the compression side of the cylinder, and means communicating with the cylinder for the admission and explusion of fluid to be compressed.

3. A compressor of the character described, comprising a main supporting plate, a cover plate, a pair of cylinder heads and an interposed cylinder secured thereto, a shaft journalled in the cylinder heads and extending through the cylinder, a rotor secured to the shaft and provided with a plurality of reciprocally mounted, radially disposed vanes, said rotor and shaft being eccentrically positioned with relation to the cylinder, a cup shaped casing enclosing the cover plate, the cylinder heads and the cylinder, said cup shaped casing being spaced therefrom to form an intermediate chamber, said cup shaped casing being secured to the supporting plate, a stuffing box formed on the supporting plate through which the rotor shaft extends, a jacket formed exterior thereof, means for delivering oil under pressure to said jacket, means for conveying the oil from the jacket to the annular space formed within the cup shaped casing to permit the oil to circulate around and cool

the cylinder, means for conveying the oil from said annular space to the cylinder and for delivering the oil into the cylinder on the side where compression takes place, means for delivering the fluid to be compressed to the cylinder, and common means for receiving the oil delivered to the cylinder and the compressed fluid.

4. A compressor of the character described comprising a main supporting plate, a rotary compressor supported thereby, a shaft extending through the supporting plate and connected with the compressor to drive the same, a cup-shaped casing secured to the supporting plate and enclosing the rotary compressor, said cup-shaped casing being spaced therefrom to form an intermediate chamber, means for delivering oil under pressure to said chamber, said compressor having oil inlet ports formed therein in communication with the compression side thereof, and means for conveying oil from the uppermost portion of the intermediate chamber to said oil inlet ports.

5. A compressor of the character described, comprising a cylinder, an inner and an outer cylinder head mounted at each end thereof, a shaft journalled in the cylinder heads and extending through the cylinder and through the inner head, said shaft being eccentrically positioned with relation to the cylinder, a rotor secured to the shaft within the cylinder, said rotor being provided with radially disposed, reciprocally mounted vanes, said cylinder being provided with an inlet and a discharge port positioned on opposite sides of the rotor, and said cylinder being further provided with an oil inlet port, said inlet port being positioned on the side of the cylinder where compression takes place, a supporting plate to which the cylinder is secured, said supporting plate having inlet and discharge ports formed therein in communication with the cylinder inlet and discharge ports, a cup shaped casing secured to the supporting plate and enclosing the cylinder, said casing being spaced from the cylinder to form an oil circulating and cooling chamber, a jacketed stuffing box formed on the supporting plate through which the rotor shaft extends, means for delivering oil under pressure to said jacketed stuffing box means for conveying the oil from said jacket to the oil circulating and cooling chamber, and means for conveying the oil from said chamber to the oil inlet port of the cylinder.

6. A compressor of the character described, comprising a cylinder, an inner and an outer cylinder head mounted at each end thereof, a shaft journalled in the cylinder heads and extending through the cylinder and through the inner head, said shaft being eccentrically positioned with relation to the cylinder, a rotor secured to the shaft within the cylinder, said rotor being provided with radially disposed, reciprocally mounted vanes, said cylinder being provided with an inlet and a discharge port positioned on opposite sides of the rotor, and said cylinder being further provided with an oil inlet port, said inlet port being positioned on the side of the cylinder where compression takes place, a supporting plate to which the cylinder is secured, said supporting plate having inlet and discharge ports formed therein in communication with the cylinder inlet and discharge ports, a cup shaped casing secured to the supporting plate and enclosing the cylinder, said casing being spaced from the cylinder to form an oil circulating and cooling chamber, a jacketed stuffing box formed on the supporting plate through which the rotor shaft extends; means for delivering oil under pressure to said jacketed stuffing box, means for conveying the oil from said jacket to the oil circulating and cooling chamber, and means for conveying the oil from said chamber to the oil inlet port of the cylinder, said means comprising a vertical standpipe communicating at its upper end with the upper portion of said chamber, and at its lower end with the oil inlet port of the cylinder.

7. A compressor of the character described comprising a main supporting plate, a rotary compressor supported thereby, a shaft extending through the supporting plate and connected with the compressor to drive the same, a cup-shaped casing secured to the supporting plate and enclosing the rotary compressor, said cup-shaped casing being spaced therefrom to form an intermediate chamber, means for delivering oil under pressure to said chamber, said compressor having oil inlet ports formed therein in communication with the compression side thereof, and a pipe connected with said inlet ports at one end, the other end of said pipe terminating in the uppermost portion of the intermediate chamber, said pipe forming a fluid duct for the oil under pressure and also preventing the formation of a gas pocket in the upper portion of the intermediate chamber.

8. A compressor of the character described comprising a main supporting plate, a rotary compressor supported thereby, a shaft extending through the supporting plate through which the rotary compressor is driven, a stuffing box on the supporting plate through which said shaft extends, a jacket exteriorly of said stuffing box, a cup-shaped casing secured to the supporting plate and enclosing the rotary compressor, said cup-shaped casing being spaced therefrom to form an intermediate chamber, means for delivering oil under pressure to the stuffing box jacket, means for transferring the oil from said jacket to the interme-

diate space between the cup-shaped casing and the compressor, and means for transferring the oil from said intermediate space to the compression side of the rotary compressor.

9. The combination with a compressor of the character described, of a cup-shaped casing enclosing the compressor, a plate supporting the compressor and also the cup shaped housing, said cup shaped casing being spaced from the compressor to form an intermediate chamber, a stuffing box formed on the supporting plate through which a shaft in the compressor extends, a jacket formed exteriorly of the stuffing box, means for delivering oil under pressure to said jacket, means for conveying the oil from the jacket to the annular space formed within the cup-shaped casing to permit the oil to circulate around the compressor and cool the same, and means for conveying the oil from said annular space into the cylinder and for delivering the oil on the side where compression takes place.

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